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Efficiency of Commercial Bacteriophages on Stec O157:H7 Populations in Beef Kept Under Vacuum and Aerobic Conditions

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Objectives

High event period (HEP) is a specific time length when processing facilities experience an elevated rate of STEC contamination. STEC contamination during beef fabrication is assessed by sampling trim combos usually using N60, N60 plus, or CSD cloth methods. However, beef primals produced during high event periods can also be affected and must be assessed. A common industry practice consists in reworking primals by removing them from vacuum sealed bags, treating with antimicrobials, repackaging, and then test for STEC. In this study, we evaluated the efficiency of bacteriophage and organic acid applications on contaminated beef kept under vacuum and aerobic conditions.

Materials and Methods

Antimicrobials used in this study included: PhageGuard E (PGE, 10^8 PFU/ml, Bacteriophage solution from Micreos Food Safety BV), peroxyacetic acid (PAA, 400 PPM), and lactic acid (LA, 4.5% at 50°C). STEC O157:H7 strains included: ATCC® 35150 (stx1 and stx2 positive), ATCC® 43895 (stx1 and stx2 positive), ATCC® 43894 (stx1 and stx2 positive), and Micreos 128. Bacteriophage killing efficiency was determined for individual strains in vitro. Fresh rose meat (*Cutaneous trunci*) was cut into 100 cm^2 and stored at 7°C. Meat samples (n = 160, 5 reps, 2 experimental units per rep) were randomly assigned to a 4×2×2 factorial whereas fixed effects were antimicrobial treatment (Control, PGE, PAA, and LA), packaging (V- vacuum and NV– aerobic), and lysing time (30 min and 6 h). Samples were inoculated with 500 ML of a STEC cocktail containing all 4 strains and after 30 min at 7°C under vacuum or wrapped in permeable film, samples were treated with 500 µL PGE, sterile buffered peptone water (BPW, Control), LA, or PAA. Samples were then re-vacuumed or re-wrapped with oxygen permeable film and kept either for 30 min or 6h at 7°C. After refrigeration, samples were swabbed and homogenized in 1mL of BPW. The swab content was serially diluted and spread-plated onto LB agar plates for bacterial enumeration. Data were analyzed using SAS as a completely randomized design.

Results

In vitro killing efficiency was 98.3%, 96.7%, 97.2%, and 98.2% for Micreos 128, ATCC® 43894, ATCC® 43895, and ATCC® 35150 strains, respectively. When analyzing the effects of antimicrobials, packaging, and lysing time, a three-way interaction was observed (P = 0.035). Under aerobic conditions for 30 min, PGE reduced STEC in beef by approximately 1.4 log CFU/cm^2 whereas organic acids reduced by 0.5 log. Similar results were observed when samples were kept for 6 h. Under vacuum conditions for 30 min, PGE significantly reduced STEC by 1 log, whereas no significant effects were observed when treating beef with PAA and LA. Under vacuum conditions for 6h, PGE significantly reduced STEC loads by 1.4 log, whereas LA reduced by 0.6 log and no differences were observed between control and PAA treatments.

Conclusion

Bacteriophage applications on beef contaminated with STEC yielded the lowest counts when compared to PAA and LA. Although organic acids led to a significant decrease of STEC loads in beef kept under aerobic conditions, bacteriophage application led to the lowest counts. Similar to reworking and testing primals produced during a HEP, while under vacuum conditions, bacteriophage significantly reduced STEC loads whereas no or minimal effects of organic acids were observed.